(12) UK Patent Application (19) GB (11) 2 231 500 (13) A

(43) Date of A publication 21.11.1990

(21) Application No 8911222.1

(22) Date of filing 16.05.1989

(51) INT CL[5]
A61H 3/04

(52) UK CL (Edition K)
A6M M10 M21E

(56) Documents cited
US 4261561 A

(58) Field of search
UK CL (Edition K) A6M M10 M21E
INT CL[5] A61H
Online databases: WPI

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(54) Walking support orthosis

(57) A wheeled frame orthosis, provides adjustable support and control to a patient suffering from cerebral palsy or of similar medical condition, allowing them to stand, walk and steer the device by turning their body in the desired direction of travel. The support e.g. back plate (1, fig 6) and chest strap, or a full brace (fig 5) is such, so as to leave the hands free. The amount of lifting support is adjusted by turning knob (52, fig 14) to compress support spring 48 so that when added to the amount being exerted by the patient, is sufficient to support the patient while walking. Brakes (66, fig 19) are automatically applied to the wheels when the patient no longer provides their own proportion of lifting support and so slumps in the frame, thus rotating arm 42 and bulling cable 59. This is both a safety feature and a means of encouraging a patient to make progress.

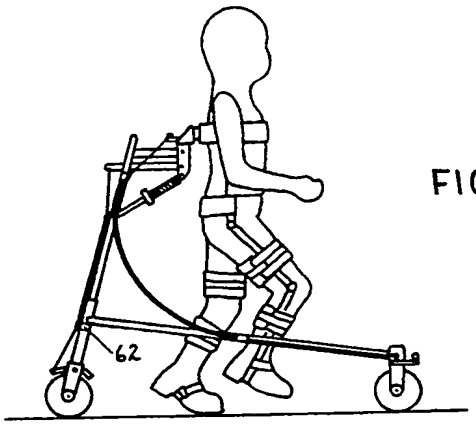

FIG3

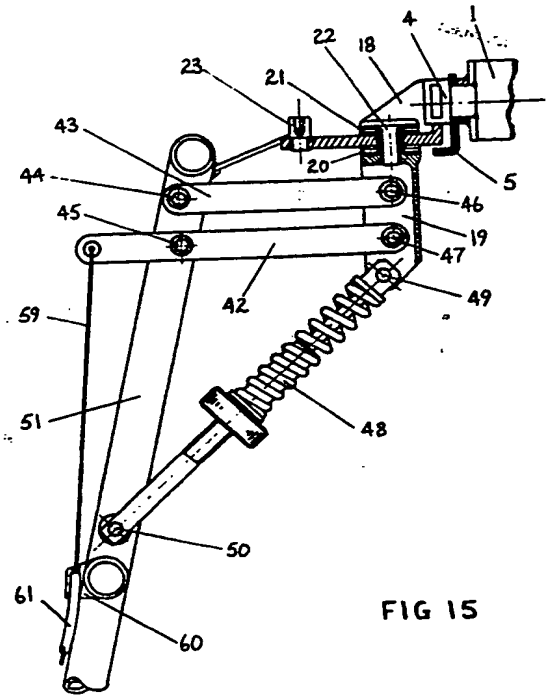

FIG 15

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

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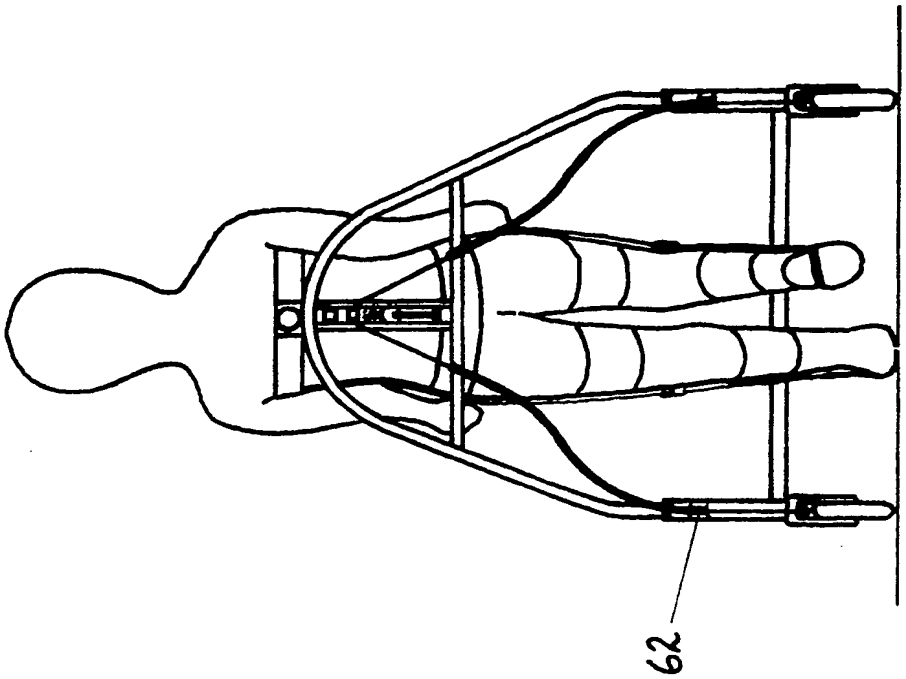


FIG 2

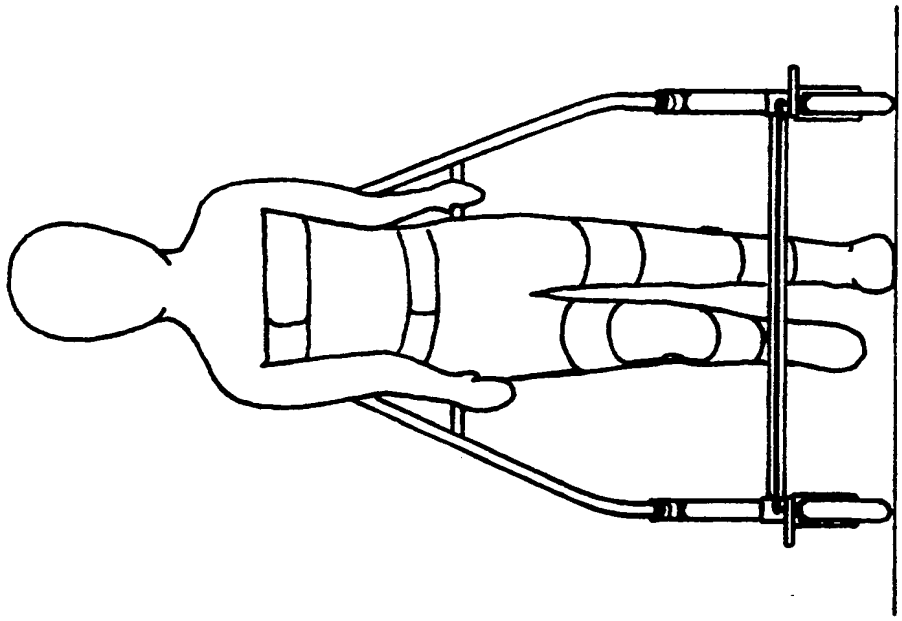


FIG 1

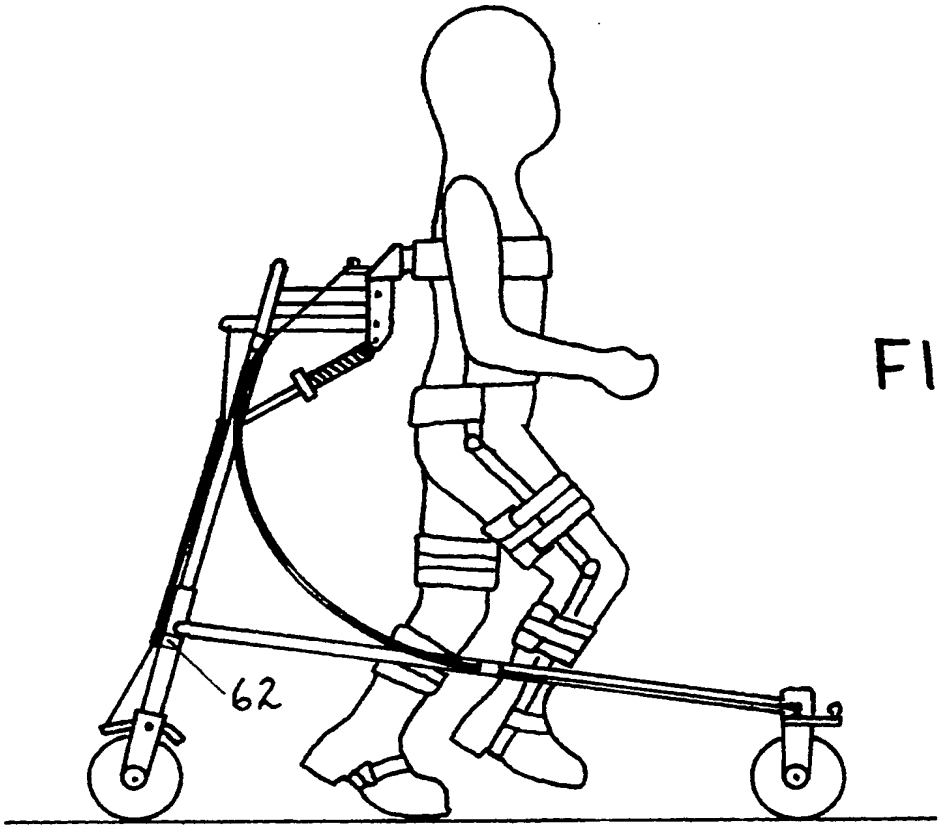


FIG 3

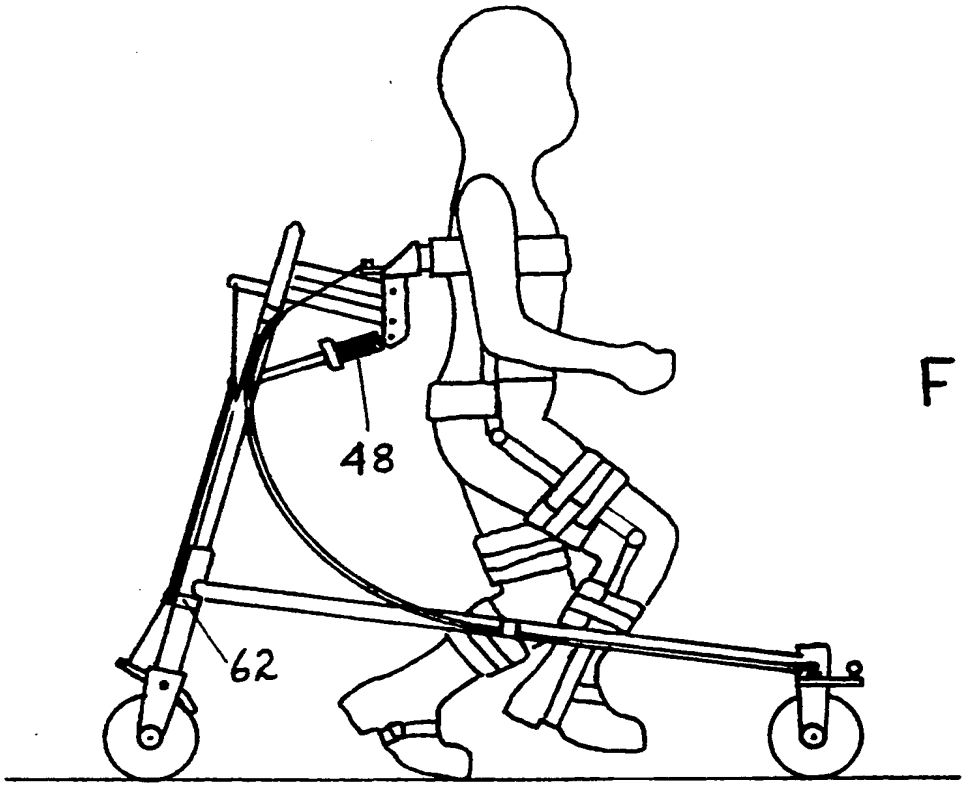


FIG 4

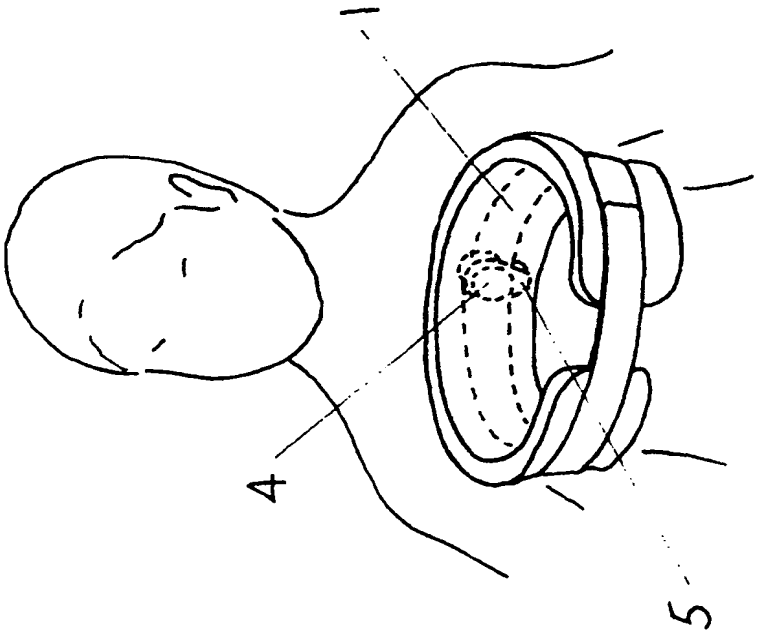


FIG 6

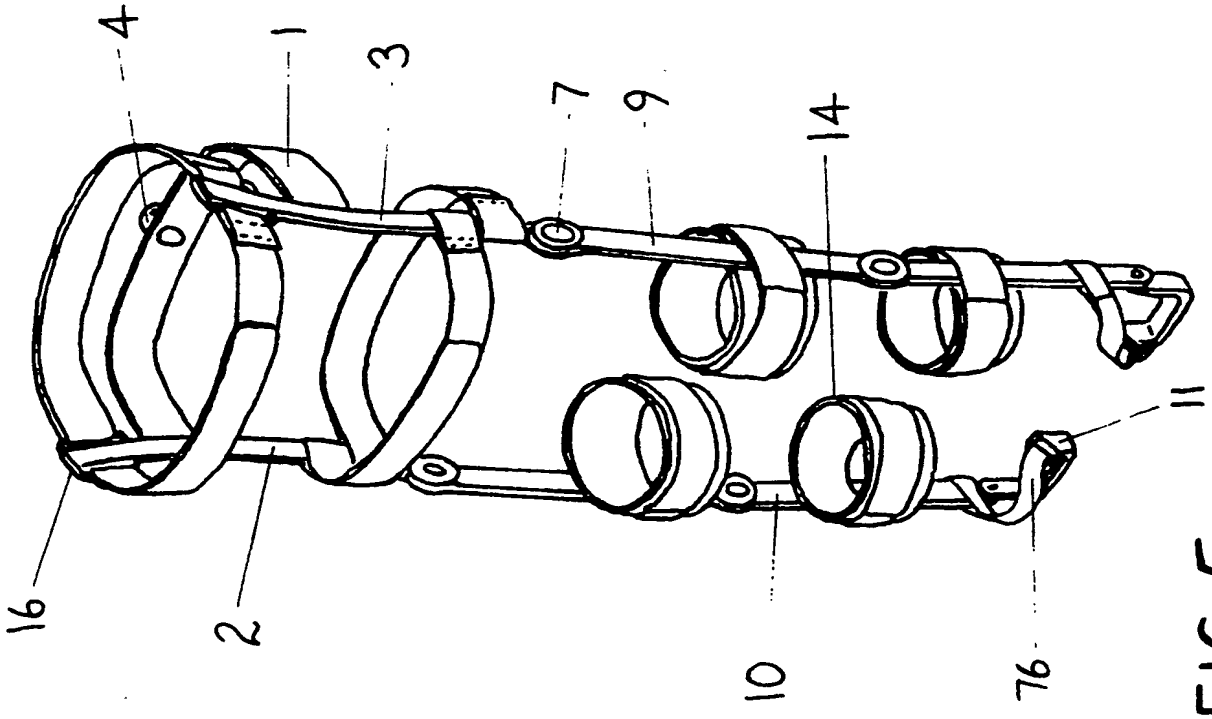


FIG 5

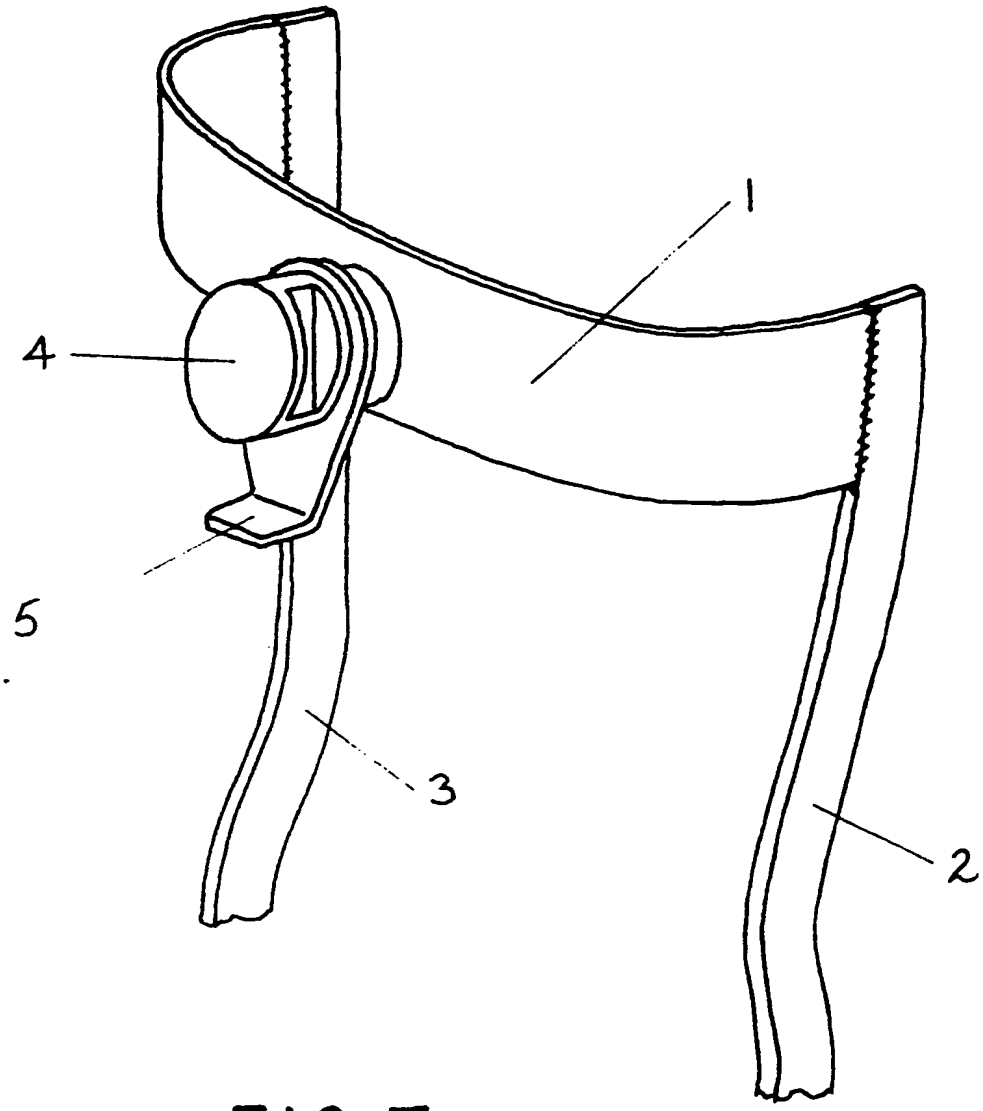


FIG 7

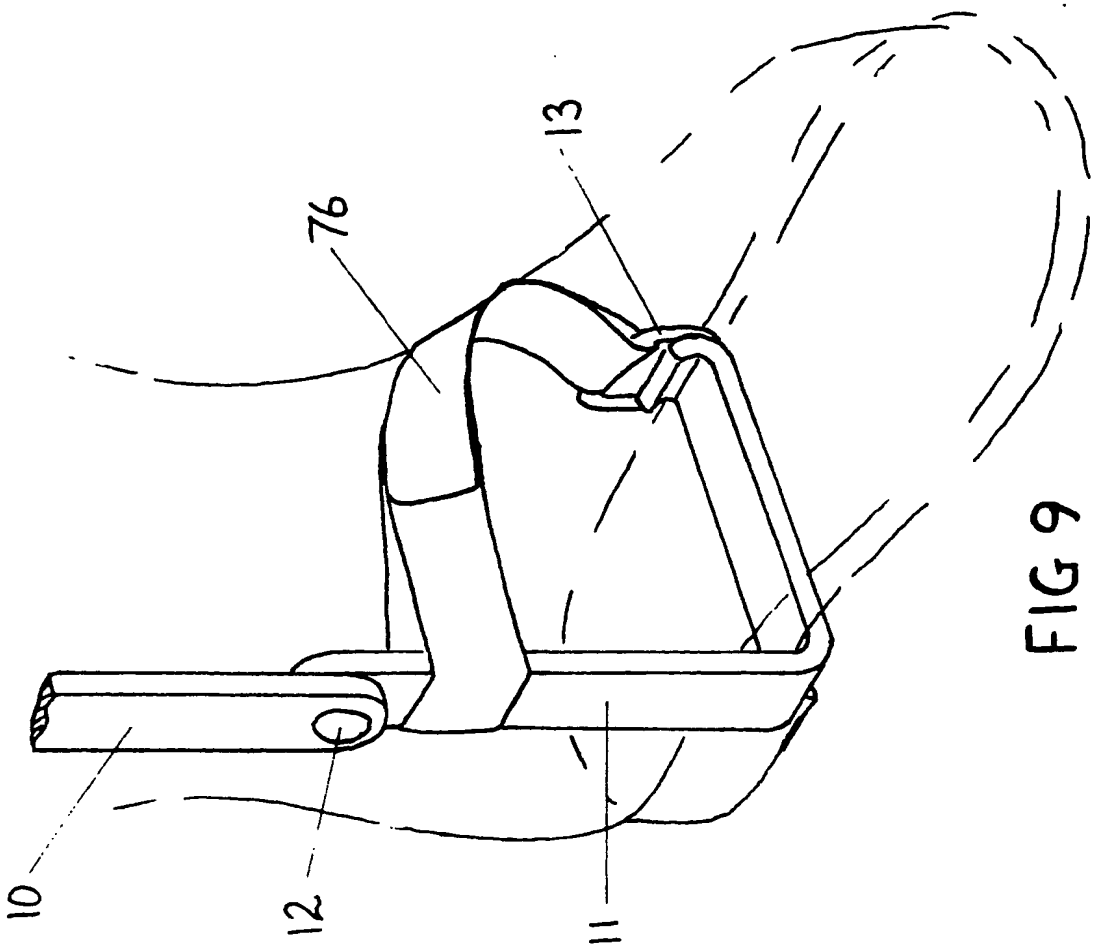


FIG 9

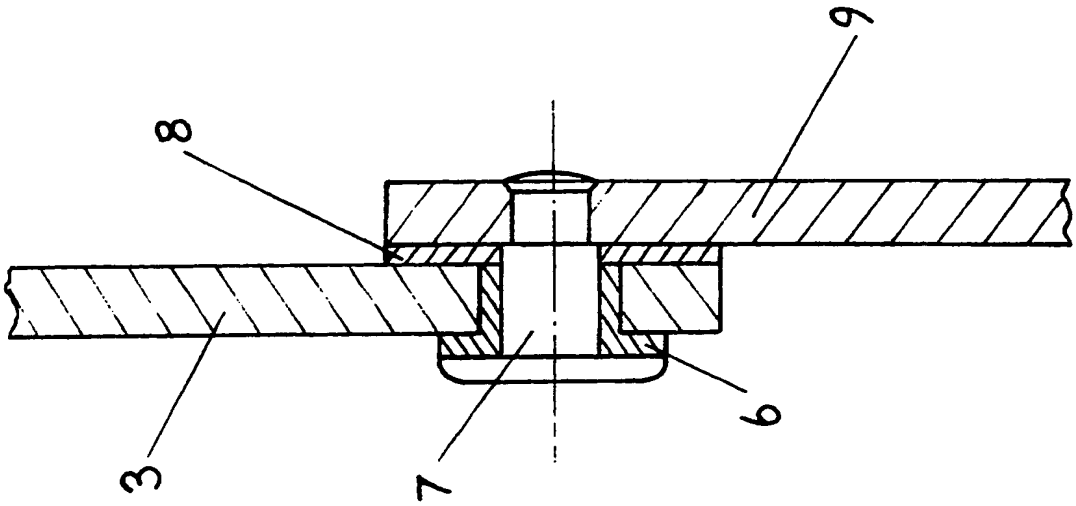


FIG 8

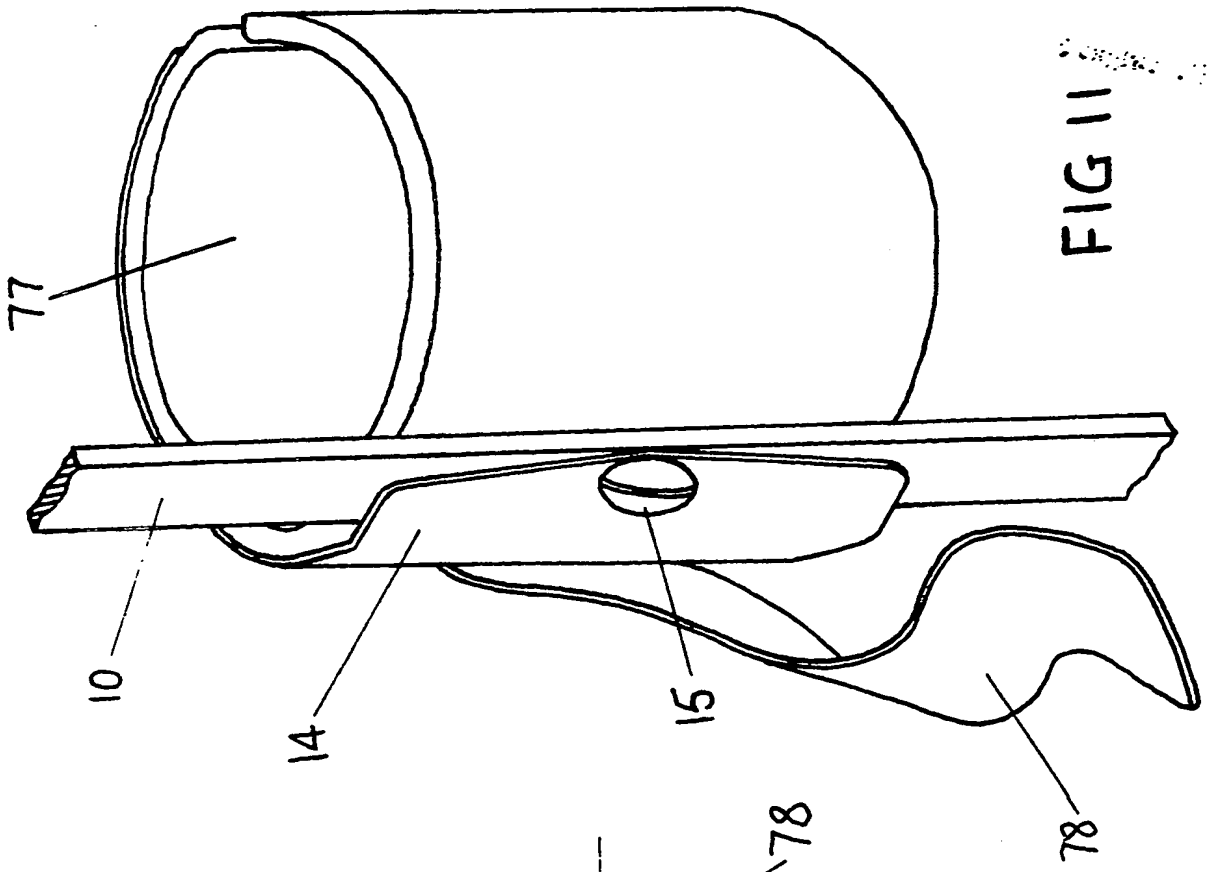


FIG 11

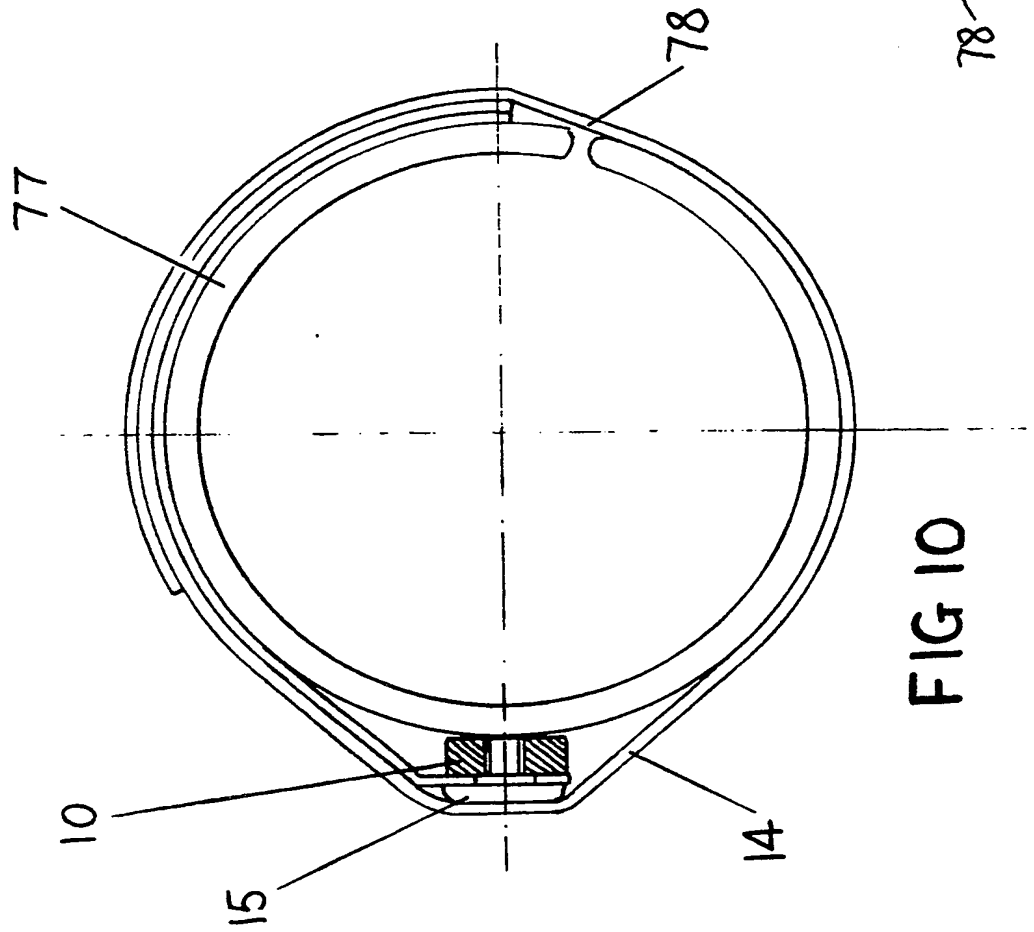


FIG 10

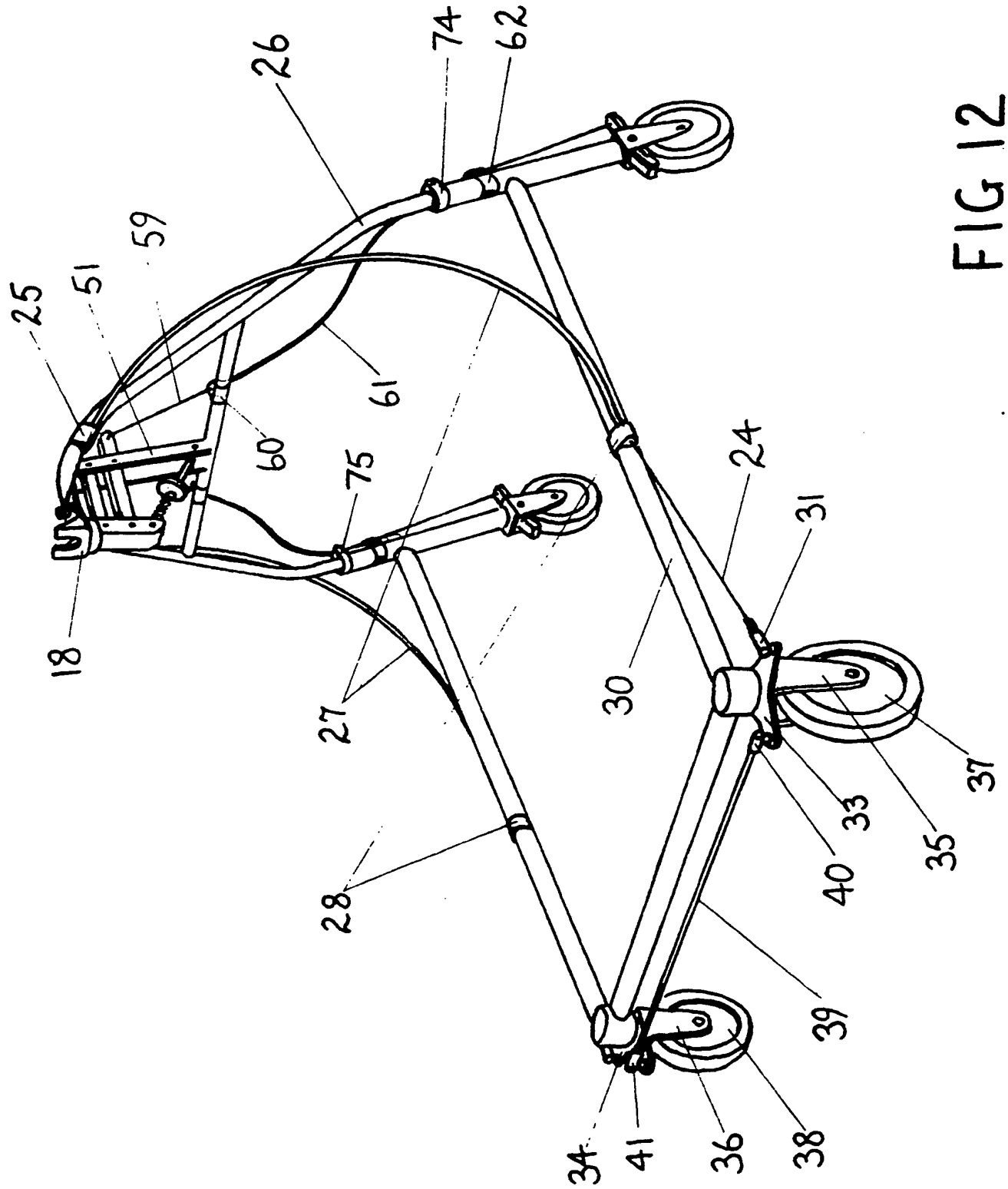
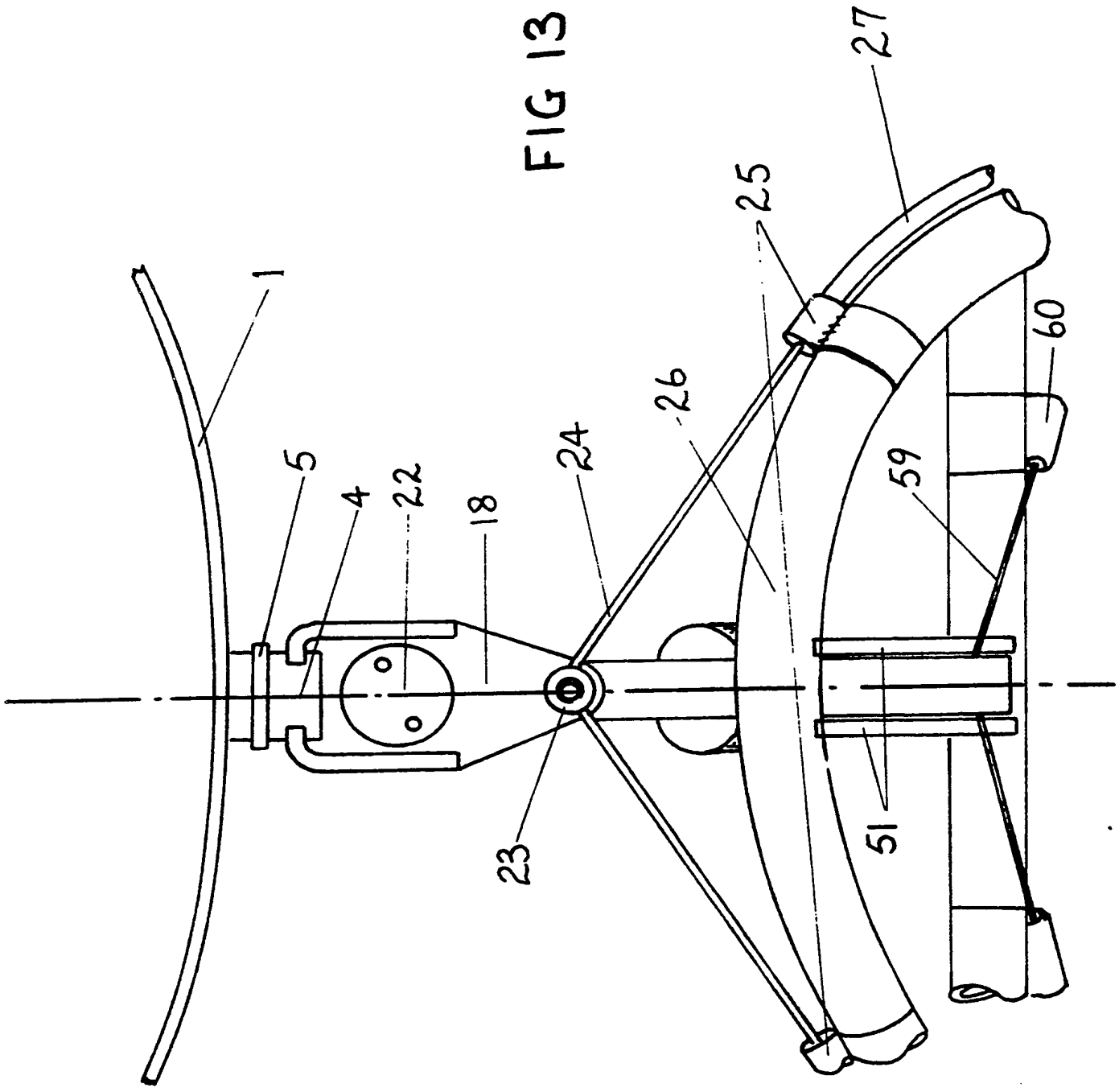


FIG 12

FIG 13



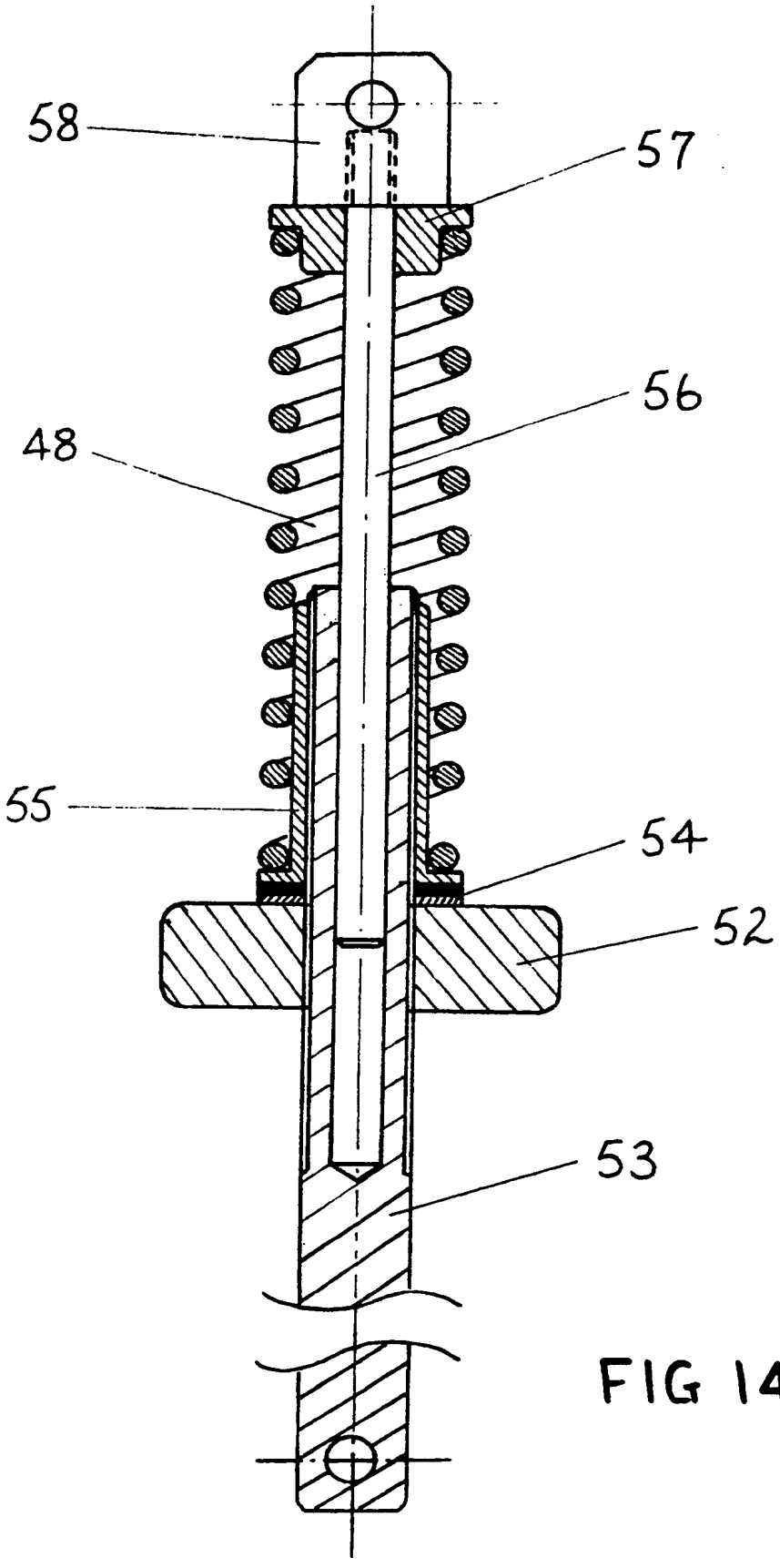


FIG 14

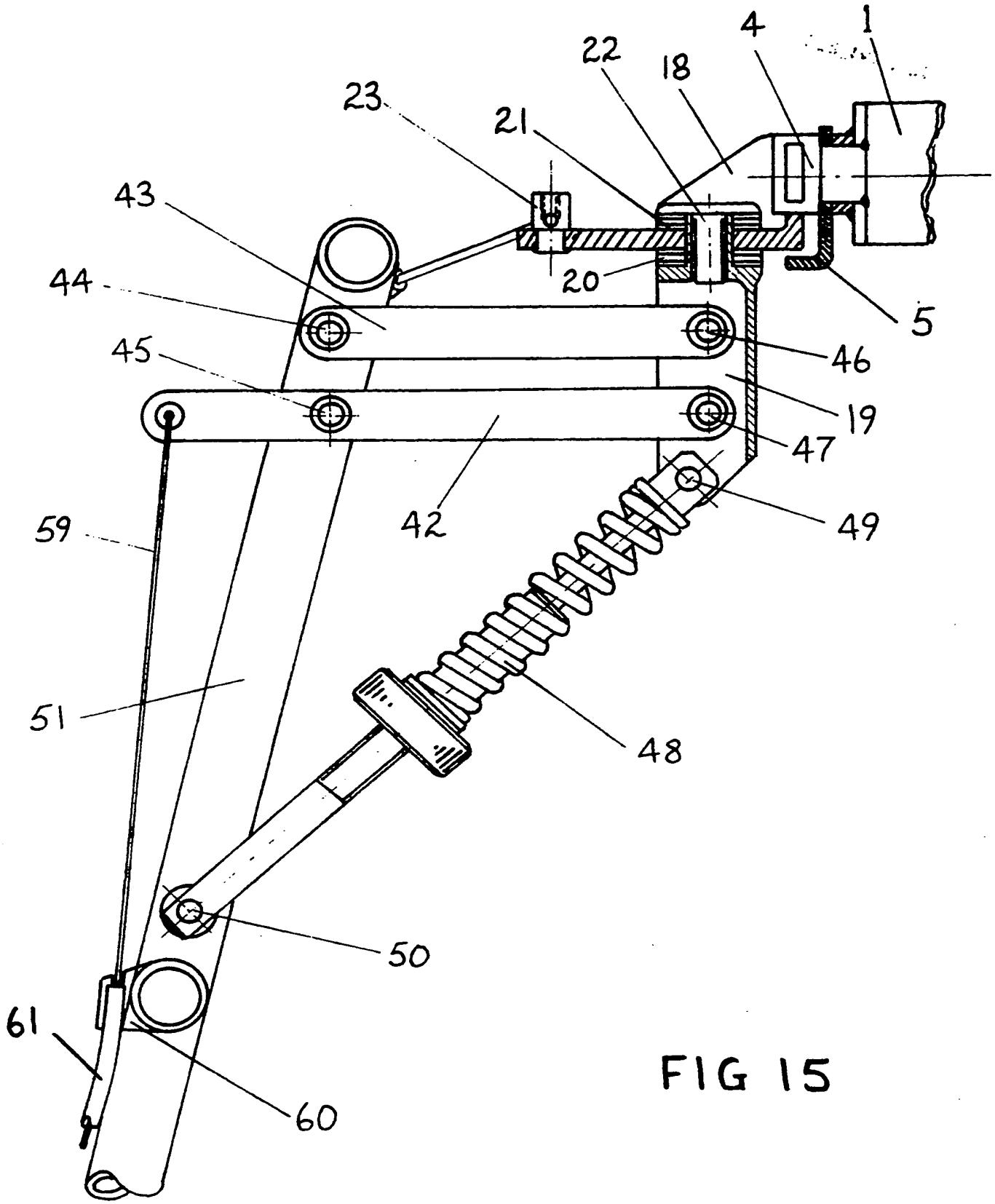


FIG 15

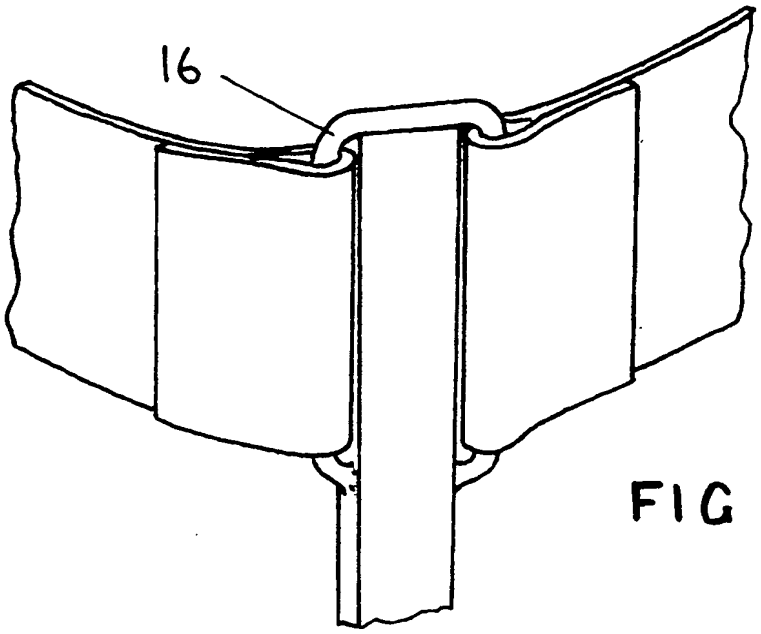


FIG 16

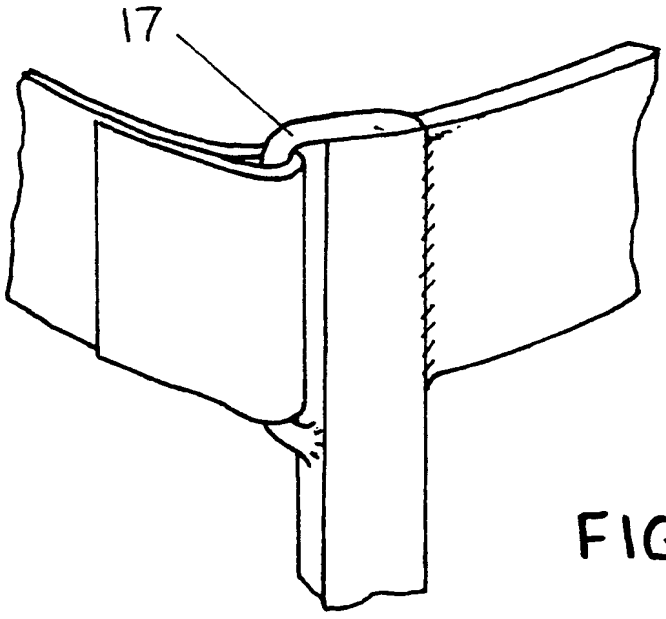


FIG 17

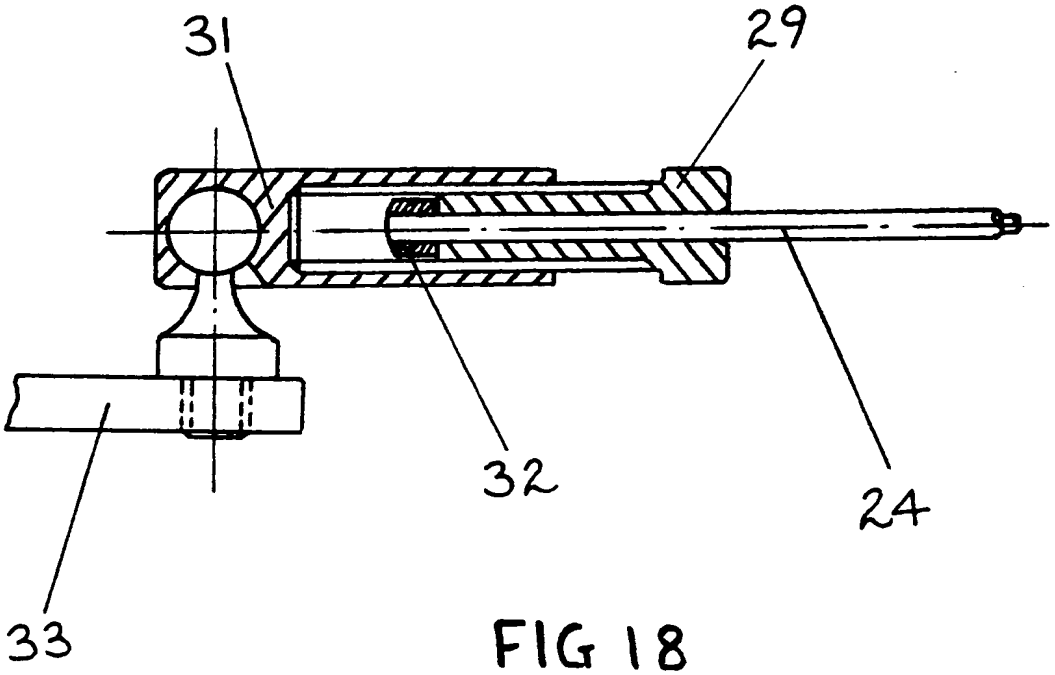


FIG 18

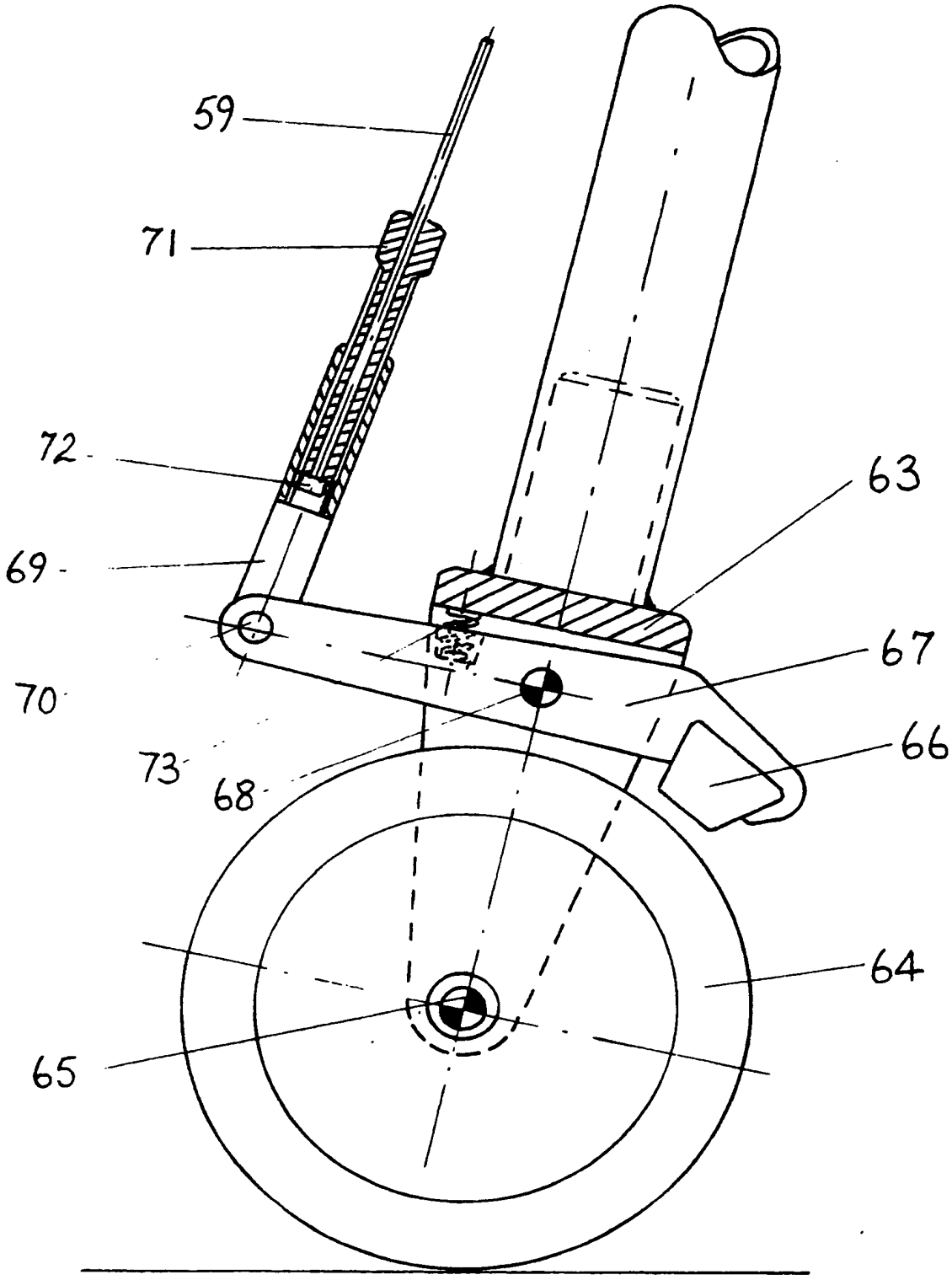


FIG 19

WALKING SUPPORT ORTHOSIS

This invention relates to an orthosis to provide adjustable support and control to a patient suffering from cerebral palsy or of similar medical condition, allowing the patient to stand and walk.

There is no known cure for cerebral palsy. Therefore, treatment for the condition is aimed at helping the patient make best use of his or her physical abilities. For many people with cerabral palsy, there are available braces and other devices that can provide that degree of support which will enable the person to walk, but for many, the severity of their condition prevents them from even attaining a standing position. This invention is intended at offering the necessary support and means for those people to learn to walk.

According to the present invention there is provided a walking support orthosis comprising a wheeled frame, support mechanism, means for body bracing, means for releasably securing body brace to support mechanism, means for patient to control steering of wheeled frame, means for adjusting amount of lifting support to the patient, means for automatically braking the rear floor wheels in the event of the patient failing to maintain an upright posture.

For a better understanding of the present invention , reference will now be made by way of example to the accompanying drawings in which:-

Figures 1 to 4 show a patient using the support orthosis;

Figure 5 illustrates an example of full body brace;

Figure 6 illustrates an example of minimum body bracing;

Figure 7 shows in perspective, the back plate welded to brace bars;

Figure 8 shows cross section of brace hinge;

Figure 9 shows example of foot bracing;

Figures 10 and 11 illustrate an example of a leg support trough;

Figure 12 shows a perspective view of wheeled frame;

Figure 13 shows top view of support assembly;

Figure 14 shows cross section of support adjusting mechanism;

Figure 15 shows side view of support assembly;

Figures 16 and 17 show examples of attaching straps to brace bars;

Figure 18 illustrates cable ball joint and

Figure 19 shows example of rear wheel brake arrangement.

The illustrated walking support orthosis of Figures 1 to 4 comprises a full body brace being worn by the patient. The amount or extent of body bracing needed for a patient to start to use and gain full benifit from the present invention is dependant on the condition of the individual patient. Figure 5 shows an example of a full body brace - see Figure 7 - with back plate 1 welded to body bars 2 and 3. Back plate 1 is positioned at the greatest practical distance above the patients centre of gravity, the mounting boss 4 and safety catch 5 - see Figures 13 and 15 - being central and square to the vertical line of the body brace. As an alternative to welding, the back plate 1 can be attached to the brace bars 2 and 3 by overlapping and the use of rivets.

The patient being supported in an upward direction at a point above their centre of gravity renders any hip, knee or foot bracing to be of a gait guidence or corrective application rather than that of a floor to upper body weight bearing support and therefore eliminates the need for locking hip and knee hinges when the patient is standing or walking.

Figure 8 shows a cross section of hip hinge, the knee hinge being of the same configuration. Headed bush 6 is a press fit in bore of brace bar 3. Headed stepped hub 7 is a slide fit through bush 6 and hardened steel thrust washer 8, the bore of brace bar 9 being a press fit on smaller diameter of hub 7, the pertruding end of which is riveted to secure the assembly. The dimensions of the assembled components provide a free swing hinge with the minimum of side play.

Figure 9 illustrates a simple means of bracing the foot when the condition of the patient requires such to make use of the present invention. Brace bar 10 is jointed to stirrup 11 by means of headed solid rivet 12. Stirrup 11 locates directly in front of the heel of a stout boot or shoe, the hooked end engaging the welt. The stirrup width being of such that it forms a close fit across the sole and is held in place by strap 76, which passes around the stirrup upright over the boot or shoe and through steel loop 13 which is welded or brazed to the hook end of the stirrup. The strap fastens by the use of velcro.

Figures 10 and 11 illustrate the leg trough, the thigh trough being of the same configuration. Trough 14 is attached to brace bar 10 with headed shouldered screw 15, the entry to the trough being at the front of the brace. The dimensions of the components of this assembly allowing the trough 14 to pivot about the screw 15 sufficiently as to align to the patients leg when fitted. To the inner surface of trough 14 is adhered a durable foam plastic 77 which continues so as to surround the patients leg. This protects the leg from direct contact with the wide strap 78 which fastens around the entire assembly making use of velcro and secures the leg within the trough.

Chest, waist, pelvic and any additional corrective bracing straps that an idividual patient may require are stitched so as to form a loop around the brace bars in their required positions. Referring to figures 16 and 17. In situations when a strap cannot be looped around a brace bar, then additional strap loops 16 and 17 being examples, are welded or brazed to the brace bar at the required positions to accommodate the straps. All body straps are preferably made from leather with velcro means of fastening.

Brace bars are bent so as to conform to the profile and needs of the individual patients.

Figure 6 shows an example of the minimum amount of body bracing needed to make use of the present invention. This brace could be used by a patient whom only required lifting, holding and stability support, their legs, although not able to support their own body weight, being able to follow the correct gait without the need for corrective bracing. This example brace comprises a mounting boss 4, safety catch 5 and back plate 1. The back plate 1 being well covered on all surfaces by a durable plastic foam which continues around the front to protect the patient from the retaining strap, this then being covered with a soft leather, ensuring that the stitching of such is kept to the lower edge to prevent the risk of skin damage to the patient. The patient is secured within the brace by a wide leather strap which fastens by the use of velcro.

By adding brace bars 2 and 3 to back plate 1 with pelvic and waist straps fitted, then this brace would provide pelvic support. If the hip hinges, thigh brace bars and thigh troughs were then added, then the brace would now also provide support and guidance to the patients hip joints and so the brace can be added to, to meet the requirements of each individual patient.

Referring to Figures 7, 12, 13 and 15. The patient is placed into the body brace while it is laid on a bed or any convenient flat soft surface. When all straps are secure, the patient can be lifted in the brace and easily attached to the support by moving safety catch 5 to one side and sliding mounting boss 4 downwards into the receiving slot of swivel bracket 18, safety catch 5 is free to rotate about mounting boss 4 and will swing into position with its tab located under swivel bracket 18 and thus preventing accidental disengagement. This arrangement makes for a safe, quick and easy means of attachment.

Referring to Figure 15. Swivel bracket 18 is mounted on and free to rotate about the vertical hub of carrier block 19, roller thrust bearing set 20 is located on the hub beneath swivel bracket 18 and roller thrust bearing set 21 is located on the hub above swivel bracket 18.

The hub of carrier block 19 is internally screw-threaded so as to receive bearing screw 22. This assembly provides a vertical axis about which the patient is able to turn his or her body and brace within the frame and provides the means for steering the front floor wheels in the following manner:-

Referring to Figures 13 and 15. Attached to swivel bracket 18 is cable puller 23 having a horizontal hole to take a Bowden cable 24 or the like and a vertical screw threaded hole to receive a grub screw which locks the cable 24 within the cable puller 23. Conduit end retainers 25 are attached to top tube 26 and retain the respective upper ends of each conduit 27.

The lower conduit end retainers 28 - see Figure 12 - are attached to wheeled frame 30, into which the second end of each conduit 27 is retained. Each end of cable 24 passes from cable puller 23, along the bore of their respective conduits 27 and out along the sides of wheeled frame 30, the ends of cable 24 then being retained within ball joints 31 - see Figure 18 - which are attached to their respective steering plates 33 and 34, these being welded to their respective front wheel forks 35 and 36.

Referring to Figure 18. Cable 24 is retained within the ball joint 31 by ferrule 32. cable adjuster 29 through which the cable 24 passes is externally threaded and screws into the threaded bore of the ball joint 31 and pushes against ferrule 32 which acts as an adjuster to take up any slack in the length of cable 24. The opposite end of cable 24 being attached in the same configeration to the opposite steering plate 34.

Referring to Figure 12. the front wheel forks 35 and 36 retain the front wheels 37 and 38 which can turn freely on their axials. The front wheel forks 35 and 36 being able to turn about a vertical axis and being interconnected with tie rod 39 each end of which is fitted with a threaded ball joint 40 and 41 each attached to their respective steering plates 33 and 34, provides the means to maintain front floor wheel parallelism.

The cable 24 and tie rod 39 form a loop steering system, making so that when the patient turns their body and body brace within the frame to face the intended direction of travel, so too do the front floor wheels.

The adjustable support mechanism allows for control of the upward support force being applied to the patient through his or her body brace. The amount of lifting support being adjusted so that when added to the amount being exerted by the patient, is sufficient to support the patient while walking. The more able the patient to support their own weight then the lesser the proportional support force required.

It is hoped that the patient making use of the present invention will gain strength, muscle control and balance so as to be able to decrease the amount of support proportionaly as the patient gains the strength and ability to support themselves, to the point where the device becomes obsolete to that person.

Figure 15 shows an adjustable support mechanism. The example illustrated forms an adjustable spring loaded parallelogram arrangement. The square section support arms 42 and 43 each pivot about their respective pivot pins. Pivot pins 44 and 45 attaching the arms 42 and 43 to support plates 51 and pivot pins 46 and 47 attaching the arms to carrier block 19, each arm being suitably bushed for the purpose. The pivoting movement of arms 42 and 43 allows carrier block 19 and its associated components to move in an upward and downward direction. The amount of force required to move carrier block 19 and its associated components in a downward direction being governed by spring 48. The spring assembly is attached at its spring end to carrier block 19 with pivot pin 49 and attached at its rod end to the support plates 51 by pivot pin 50.

Figure 14 shows an example of an adjustable spring assembly. Spring adjuster 52 is internally screw-threaded and is located on threaded shaft 53. Roller thrust bearing set 54 is located on shaft 53 between adjuster 52 and spring retainer 55 which makes for easy adjustment under load.

Spring 48 locates onto spring retainer 55, the length of this retainer protecting the thread of shaft 53 from the spring. The threaded end of stabilizing bar 56 is screwed into threaded bore of pivot block 58 with short spring retainer 57 located on stabilizing bar 56 and on the inside diameter and end of spring 48 with its outer face against that of pivot block 58. The plain end of stabilizing bar 56 locates with a slide fit into smooth bore of shaft 53. To increase support to patient the spring adjuster 52 is turned by hand in a direction so as to compress the spring and turned in the opposite direction to decrease the support.

Figure 4 illustrates a patient using the present invention and in a situation when their legs are no longer offering any support to their body weight, their body becoming lower within the frame as the spring 48 takes all of the patients weight. This downward movement is used to apply braking to the rear floor wheels. The reasons for doing this are many, for example:- Preventing the patient from loosing control of the device, preventing the more abled from lifting their feet from the floor and joy riding. The most constructive reason being that of encouraging the more able patient to take more of their own weight and thus make progress towards independence and not reliant on the device.

Referring to Figure 15. Brake cable 59 passes through an eyelet located at the outer end of support arm 42. The cable is free to slide through the eyelet and this makes for the forces in the cable being evenly distributed to each of the two brakes. The arrangement for each of the two rear brakes is the same and for easier understanding the arrangement of just one side will be explained:-

Any downward movement by the patient causes support arm 42 to move about pivot 45, this movement being in an upwards direction at the brake cable end of arm 42 and thus pulling on brake cable 59. which is free to move within its conduit 61, the upper end of which is retained by retainer 60 attached to the frame cross tube.

The lower end of conduit 61 is retained by retainer 62 attached to the rear of the frame above the rear wheel fork 63. See Figures 2, 3, 4, 12 and 13.

Referring to Figure 19. This shows the rear wheel braking arrangement. Rear wheel fork 63 is located in the frame tube by its boss and is welded or pinned in a position so that the floor wheel follows a path that is parallel to the front to rear centre line of the frame. Floor wheel 64 is free to turn about pivot 65. Brake block 66 is a drive fit in the dove-tail cross slot of brake lever 67. Brake lever 67 is free to pivot on pivot pin 68 and is reduced in width at the lever end to take the forked end of cable length adjuster 69 which is free to pivot on pivot pin 70. The brake cable 59 passes through the centre bore of adjusting screw 71 and is retained with ferrule 72 at its end. Adjusting screw 71 engages into threaded bore of adjuster 69 and is used to set the point at which the brake block makes contact with the floor wheel relative to the vertical position of the patient when using the device. Any extreme of downward movement by the patient automatically causing brake block 66 to make contact with the wheel. The spring 73 causing brake block 66 to move away from wheel 64 when the patient is offering support to their own body weight. This arrangement for braking is common to both rear wheels.

By supporting the patient at a point above their centre of gravety, it makes it unnecessary for the patient to use their hands to hold onto any additional support. This fact allows the patient for example, to approach a table and engage in any desired hand activity on its work top. The front of the frame being low so as to pass under such.

Referring to Figure 12. The frame tube 26, to which the adjustable support mechanism is mounted, slides into the bore of the upright tubes of wheeled frame 30 in a telescopic fashion. This allowing for height adjustment to be made to the support and is locked with clips 74 and 75. This catering for a childs growth and for the height of individual patients.

CLAIMS

1 A walking support orthosis which provides adjustable support and control to a patient suffering from cerebral palsy or of similar medical condition, allowing the patient to stand and walk while leaving the patients hands free, in which the walking support orthosis comprises a wheeled frame, support mechanism, means for body bracing, means for releasably securing body brace to support mechanism, means for patient to control steering of wheeled frame, means for adjusting amount of lifting support to the patient, means for automatically braking floor wheels in event of patient failing to maintain an upright posture.

2 A walking support orthosis as claimed in Claim 1 wherein the support force being applied to the patient is through the body brace in a vertically upward direction by means of a support mechanism in the form of a spring loaded parallelogram arrangement, one end member of which is secured to the uprights of the wheeled frame, the other vertically moveable end member forms a vertical hub which houses the swivel bracket to which the body brace is releasably secured.

3 A walking support orthosis as claimed in Claim 2 wherein the support force being applied to the patient is provided by means of a helically-coiled spring acting between the wheeled frame uprights and the vertically moveable end member of the support mechanism, an adjusting nut being provided to adjust the compression of the helically-coiled spring and thus as a result of which the support force to the patient is adjusted.

4 A walking support orthosis as claimed in any preceding claim wherein the

patient is supported through the body brace which is releasably secured to the support mechanism at a point above the patients centre of gravity rendering any bracing of the patient below this point to be of a gait guidence or corrective application rather than that of floor to upper body weight bearing support and therefore eliminating the need for locking hip and knee hinges and allowing a more abled patient to benefit from the walking support orthosis with the minimum of bracing.

5 A walking support orthosis as claimed in any preceding claim, wherein means for steering of the front floor wheels is by way of the swivel bracket housed in the vertical hub of support mechanism to which the body brace is releasably secured, this arrangement providing a vertical axis about which the patient is able to turn his or her body and brace within the wheeled frame to the desired direction of travel, this movement being transmitted from the support assembly to each of the front wheel forks by means of Bowden cable or the like, causing the front floor wheels to turn about a vertical axis provided by the front wheel forks, parallelism of the front floor wheels being maintained by means of a tie rod interconnecting the front wheel fork steering plates by way of ball joints.

6 A walking support orthosis as claimed in any preceding claim, wherein lockable height adjustment means is provided to support mechanism, this being by way of the frame to which the adjustable support assembly is mounted, slides into the bore of the upright tubes of wheeled frame in a telescopic fashion and held in desired position by way of clamping clips.

7 A walking support orthosis as claimed in any preceding claim, wherein the means for braking of the rear floor wheels when patient is failing to maintain an upright posture, is by way of transmitting the up and down movement of the patient from the levers of the support mechanism through brake cables to brake block levers. Brake cable length adjusters allowing the brake blocks to be adjusted so as to cause each brake block to make contact with its relative rear wheel in the event of any extreme downward movement by the patient.

8 A walking support orthosis as described herein with reference to Figures 1-13 of the accompanying drawings.

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